Claims:

1. A semi-invasive ultrasound imaging system for imaging biological tissue, comprising:

a probe including an elongated body with a distal end comprising a two-dimensional ultrasound transducer array;

a transmit beamformer connected to said transducer array and constructed to transmit several ultrasound beams over a selected azimuthal range and a selected elevation range of locations;

a receive beamformer, connected to said transducer array, constructed to acquire ultrasound data from echoes reflected over a selected tissue volume delineated by said emitted ultrasound beams and a selected sector scan depth and synthesize image data from said acquired ultrasound data; and

an image generator constructed to receive said image data and generate at least one image of the selected tissue volume that are displayed on an image display.

2. The ultrasound imaging system of claim 1 wherein said image generator is constructed to generate, from said image data, at least two orthographic projection views over the selected tissue volume, and said image display is constructed to display said at least two projection views.

3. The ultrasound imaging system of claim 1 further including a surface detector and a control processor, said surface detector being constructed to receive image parameters from said control processor and generate surface data from the image data; said image generator being constructed to generate from the surface data a projection image for display on said image display.

4. The ultrasound imaging system of claim 3 wherein said surface detector is a B-scan boundary detector and said image generator is constructed to generate, from said image data and said surface data, a plane view including said projection image.

5. The ultrasound imaging system of claim 4 wherein said image generator is constructed to generate, from said image data and said surface data, at least two orthographic projection views each including said plane view and said projection image.

6. The ultrasound imaging system of claim 3 wherein said surface detector is a C-scan boundary detector and said image generator is constructed to generate a C-scan view.

7. The ultrasound imaging system of claim 1 wherein said transducer array and said beamformers are constructed to operate in a phased array mode and acquire said ultrasound data over said selected azimuthal range for several image sectors each having a designated elevation location.

8. The ultrasound imaging system of claim 1 wherein said transducer array includes a plurality of sub-arrays connected to said transmit and receive beamformers.

9. The ultrasound imaging system of claim 1 wherein said probe is a transesophageal probe.

10. The ultrasound imaging system of claim 9 wherein said transesophageal probe includes a locking mechanism co-operatively arranged with an articulation region of said probe and constructed to lock in place said transducer array after orienting said array relative to a tissue region of interest.

11. The ultrasound imaging system of claim 1 wherein said probe is a transnasal transesophageal probe.

12. The ultrasound imaging system of claim 11 wherein said transnasal transesophageal probe includes a locking mechanism co-operatively arranged with an articulation region of said probe and constructed to lock in place said transducer array after orienting said array relative to a tissue region of interest.

13. The ultrasound imaging system of claim 2 further including a control processor constructed and arranged to control said transmission of said ultrasound beams and control said synthesis of said image data based on data provided by a user.

14. The ultrasound imaging system of claim 13 wherein said transducer array includes a plurality of sub-arrays connectable to said transmit and receive beamformers and said control processor is constructed to control arrangement of said sub-arrays for optimizing acquisition of said echo data of said tissue volume.

15. The ultrasound imaging system of claim 13 wherein said control processor constructed and arranged to provide to said transmit beamformer and said receive beamformer scan parameters that include an imaging depth, a frame rate, or an azimuth to elevation scan ratio.

16. The ultrasound imaging system of claim 13 wherein said control processor is constructed to receive input data and provide output data causing said transmit and receive beamformers to change said azimuthal range.

17. The ultrasound imaging system of claim 13 wherein said control processor is constructed to receive input data and provide output data causing said transmit and receive beamformers to change said elevation range.

18. The ultrasound imaging system of claim 13 wherein said control processor is constructed to provide data to image generator for adjusting a yaw of said views by recalculating said orthographic projection views.

19. The ultrasound imaging system of claim 2 wherein said image generator includes at least one view interpolation processor constructed to generate said at least two orthographic projection views, at least one icon generator constructed to generate said at least two icons associated with said at least two orthographic

projection views, and at least one boundary detector constructed and arranged to detect a tissue boundary.

20. The ultrasound imaging system of claim 19 wherein the view interpolation processor is arranged to generate a B-scan view and a C-scan view, said C-scan view being generated by receiving C-scan designation information from said B-scan view.

21. The ultrasound imaging system of claim 20 wherein said C-scan designation information includes range gates.

22. The ultrasound imaging system of claim 19 wherein the view interpolation processor is an azimuthal view interpolation processor.

23. The ultrasound imaging system of claim 19 wherein the view interpolation processor is an elevation view interpolation processor.

24. The ultrasound imaging system of claim 19 wherein the view interpolation processor includes a gated peak detector.

25. The ultrasound imaging system of claim 19 wherein said image generator includes a yaw adjustment processor.

26. The ultrasound imaging system of claim 19 wherein said image generator includes a range processor constructed to provide two range cursors for generating a C-scan projection view.

27. The ultrasound imaging system of claim 26 wherein said range processor is arranged to receive a user input defining said two range cursors.

28. The ultrasound imaging system of claim 19 wherein said icon generator constructed to generate an azimuthal icon displaying said azimuthal angular range and displaying a maximum azimuthal angular range.

29. The ultrasound imaging system of claim 19 wherein said icon generator is constructed to generate an elevation icon displaying said elevation angular range and displaying a maximum elevation angular range.

30. A semi-invasive ultrasound imaging method, comprising:

introducing into the esophagus a probe and positioning a two-dimensional ultrasound transducer array at a selected orientation relative to an tissue region of interest;

transmitting ultrasound beams over a plurality of transmit scan lines from said transducer array over a selected azimuthal range and a selected elevation range of locations;

acquiring by said transducer array ultrasound data from echoes reflected from a selected tissue volume delineated by said azimuthal range, said elevation range and a selected sector scan depth and synthesizing image data from said acquired ultrasound data;

generating from said image data at least one image of the selected tissue volume; and

displaying said generated image.

31. The imaging method of claim 30 wherein said generating includes creating at least two orthographic projection views over the selected tissue volume.

32. The imaging method of claim 30 further including generating surface data by a surface detector, wherein said generating also includes generating from said surface data a projection image.

33. The imaging method of claim 32 wherein said surface detector is a B-scan boundary detector and said generating from said image data and said surface data includes creating a plane view including said projection image.

34. The imaging method of claim 33 wherein said generating includes creating at least two orthographic projection views each including said plane view and said projection image.

35. The imaging method of claim 32 wherein said surface detector is a C-scan boundary detector and said generating includes creating a C-scan view.

36. The imaging method of claim 30 wherein said transmitting and said acquiring is performed by transmit and receive beamformers constructed to operate in a phased array mode and acquire said ultrasound data over said selected azimuthal range for several image sectors having known elevation locations.

37. The imaging method of claim 30 wherein said generating includes generating at least two orthographic projection views over the tissue volume, and said displaying includes displaying said at least two orthographic projection views.

38. The imaging method of claim 37 further including positioning a surgical instrument at a tissue of interest displayed by said orthographic projection views.

39. The imaging method of claim 38 further including verifying a location of said surgical instrument during surgery based orthographic projection views.

40. The imaging method of claim 37 further including performing said transmitting, said acquiring, said generating, and said displaying of said orthographic projection views while performing surgery with said surgical instrument.

41. The imaging method of claim 37 further including performing said transmitting, said acquiring, said generating, and said displaying of said orthographic projection views after performing surgery with said surgical instrument.

42. The imaging method of claim 33 further including generating by an azimuthal icon generator an azimuthal icon associated with said selected azimuthal range and a maximum azimuthal range.

43. The imaging method of claim 33 further including generating by an elevation icon generator an elevation icon associated with said selected elevation range and a maximum elevation range.

44. The imaging method of claim 37 wherein said generating said several orthographic projection views includes generating a selected C-scan view.

45. The imaging method of claim 44 wherein said generating said selected C-scan view includes providing a C-scan designation for said selected C-scan view.

46. The imaging method of claim 45 wherein said providing said C-scan designation includes defining a bottom view.

47. The imaging method of claim 45 wherein said providing said C-scan designation includes defining a top view.

48. The imaging method of claim 44 wherein generating said C-scan includes detecting a tissue boundary by using a C-scan boundary detector, and selecting ultrasound data for said C-scan by a gated peak detector.